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IS 2749 (1974): Austenitic iron castings [MTD 6: Pig iron and Cast Iron]



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Indian Standard
SPECIFICATION FOR
AUSTENITIC IRON CASTINGS
(*First Revision*)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR AUSTENITIC IRON CASTINGS

(First Revision)

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Indian Standard

SPECIFICATION FOR AUSTENITIC IRON CASTINGS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 December 1974, after the draft finalized by the Cast Iron and Malleable Cast Iron Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1964. As a result of experience gained during these years it has been decided to revise the existing grades and incorporate a few more new grades.

0.3 Austenitic cast irons are high alloy materials in which the metallic matrix has been rendered austenitic at ambient temperature by the use of alloying elements and in which the carbon is present predominantly as either flake or spheroidal graphite. Carbides are also often present, particularly in the high chromium grades.

0.3.1 A minimum of 20 percent of nickel is usually necessary for making castings fully austenitic under normal conditions but up to one-third of the nickel content may be replaced by copper in flake graphite types and a proportion replaced by manganese in some types up to the limit when the carbide stabilizing effect of manganese renders the castings hard and unmachinable.

0.3.2 These alloy irons have better corrosion- and heat-resistant properties as compared to ordinary grey iron. They also have good wear and erosion resistance.

0.3.3 An addition of chromium up to 5 percent to austenitic irons further increases their heat corrosion and wear resistance. On the other hand, the amount of chromium that can be tolerated is limited by its tendency to raise the hardness due to the formation of carbide phase with simultaneous lowering of toughness and ductility.

0.3.4 Spheroidal graphite grades of austenitic cast iron have mechanical properties superior to those of the flake graphite types. Generally they exhibit superior resistance to heat and corrosion and have other physical properties which differ from those of the flake graphite types of similar basic composition.

0.3.4.1 In the spheroidal graphite grades of austenitic cast irons, carbon is present principally in graphite particle in spheroidal form corresponding to form VI of 'Indian Standard method for determination of microstructure of graphite in cast iron' (*under preparation*).

0.4 The ranges of chemical composition specified in this standard are suitable for normal run of castings. For castings which in service may be exposed for long periods of time to temperatures between 200 and 500°C or to sub-zero temperatures, and for larger castings (with sections over 50 mm thick) which cool slowly in the foundry, nickel, chromium and manganese should be maintained towards the upper limits of the composition range, and silicon towards the lower limit.

0.5 Where welding is to be carried out on these castings, it is recommended that spheroidal graphite type of austenitic iron should be used.

0.6 For the guidance of engineers and designers typical mechanical and physical properties of various grades of austenitic iron castings and the general information regarding their use have been given in Appendix A. In order to assist the manufacturer, the purchaser should indicate, in the enquiry and order, the purpose for which the castings are to be used.

0.7 In preparing this revision, assistance has been derived from ISO 2892-1973 'Specification for austenitic cast iron', issued by the International Organization for Standardization.

0.8 This standard contains clauses which require the purchaser to specify his requirements, if necessary, while placing an order. These clauses are **4.1, 5.2, 6.1, 6.4, 7.1.1, 8.1.1, 9.1, 10.2, 11.1, 12.2, 13.1, 13.3.1, 13.3.2.2, 13.4** and **B-2.1**.

0.9 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements for both flake graphite type and spheroidal graphite type of austenitic iron castings.

*Rules for rounding off numerical values (*revised*).

2. GRADE

2.1 There shall be nine grades of flake graphite austenitic cast iron and 11 grades of spheroidal or nodular graphite austenitic cast iron. These grades are based on the chemical composition and mechanical properties.

2.2 Designation

2.2.1 Each grade having a microstructure of flake graphite shall be designated by the initial letter 'AFG' followed by appropriately spaced chemical symbols and figures indicating the alloying elements and their approximate mean levels.

2.2.2 Each grade having a microstructure spheroidal or nodular graphite shall be designated by the initial letter 'ASG' followed by appropriately spaced chemical symbols and figures indicating the alloying elements and their approximate mean levels.

3. SUPPLY OF MATERIAL

3.1 General requirements for the supply of austenitic iron castings shall be as laid down in IS: 1387-1967*.

4. MANUFACTURE

4.1 The castings shall be made by any process as agreed to between the purchaser and the manufacturer.

5. CHEMICAL COMPOSITION

5.1 The chemical composition of the grades of austenitic cast iron shall be as given in Table 1 for flake graphite types, and Table 2 for spheroidal graphite types.

5.2 Unless otherwise specified, other elements may be present, at the discretion of the manufacturer, provided they do not alter the microstructure substantially, nor affect the properties adversely. If the presence of any element specified in Tables 1 and 2 is required outside the limits indicated, or if any other element is required, such as molybdenum, the permissible amount shall be as agreed to between the purchaser and the manufacturer, and specified on the order.

NOTE — Indian Standard Methods of chemical analysis of austenitic iron castings is, at present, under preparation. Till it is published, the methods of chemical analysis shall be as agreed to between the purchaser and the manufacturer.

*General requirements for the supply of metallurgical materials (*first revision*).

TABLE 1 CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES OF FLAKE GRAPHITE AUSTENITIC CAST IRONS

(Clauses 5.1, 5.2, 6.1.2 and 6.2)

GRADE	CHEMICAL COMPOSITION, PERCENT						MECHANICAL PROPERTY	
	C, Max	Si	Mn	Ni	Cr	Cu	Tensile Strength, Min *N/mm ²	Brinell Hardness HB, Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AFG Ni 13 Mn 7	3.0	1.5 to 3.0	6.0 to 7.0	12.0 to 14.0	0.2, Max	0.5, Max	140	150
AFG Ni 15 Cu 6 Cr 2	3.0	1.0 to 2.8	0.5 to 1.5	13.5 to 17.5	1.0 to 2.5	5.5 to 7.5	170	200
AFG Ni 15 Cu 6 Cr 3	3.0	1.0 to 2.8	0.5 to 1.5	13.5 to 17.5	2.5 to 3.5	5.5 to 7.5	190	250
AFG Ni 20 Cr 2	3.0	1.0 to 2.8	0.5 to 1.5	18.0 to 22.0	1.0 to 2.5	0.5, Max	170	215
AFG Ni 20 Cr 3	3.0	1.0 to 2.8	0.5 to 1.5	18.0 to 22.0	2.5 to 3.5	0.5, Max	190	250
AFG Ni 20 Si 5 Cr 3	2.5	4.5 to 5.5	0.5 to 1.5	18.0 to 22.0	1.5 to 4.5	0.5, Max	190	250
AFG Ni 30 Cr 3	2.5	1.0 to 2.0	0.5 to 1.5	28.0 to 32.0	2.5 to 3.5	0.5, Max	190	215
AFG Ni 30 Si 5 Cr 5	2.5	5.0 to 6.0	0.5 to 1.5	29.0 to 32.0	4.5 to 5.5	0.5, Max	170	210
AFG Ni 35	2.4	1.0 to 2.0	0.5 to 1.5	34.0 to 36.0	0.2, Max	0.5, Max	120	140

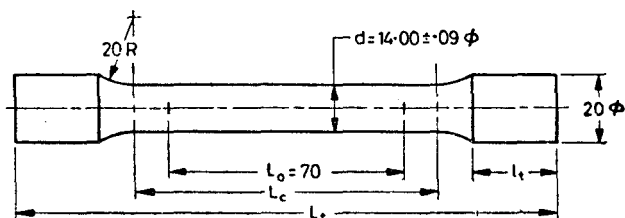
*1N/mm² = 1 MN/m² = 0.1020 kgf/mm².

TABLE 2 CHEMICAL COMPOSITION OF SPHEROIDAL GRAPHITE AUSTENITIC CAST IRONS
(Clauses 5.1 and 5.2)

GRADE	CHEMICAL COMPOSITION, PERCENT						
	C, <i>Max</i>	Si	Mn	Ni	Cr	P, <i>Max</i>	Cu, <i>Max</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ASG Ni 13 Mn 7	3.0	2.0 to 3.0	6.0 to 7.0	12.0 to 14.0	0.2, <i>Max</i>	0.080	0.5
ASG Ni 20 Cr 2	3.0	1.5 to 3.0	0.5 to 1.5	18.0 to 22.0	1.0 to 2.5	0.080	0.5
ASG Ni 20 Cr 3	3.0	1.5 to 3.0	0.5 to 1.5	18.0 to 22.0	2.5 to 3.5	0.080	0.5
ASG Ni 20 Si 5 Cr 2	3.0	4.5 to 5.5	0.5 to 1.5	18.0 to 22.0	1.0 to 2.5	0.080	0.5
ASG Ni 22	3.0	1.0 to 3.0	1.5 to 2.5	21.0 to 24.0	0.5, <i>Max</i>	0.080	0.5
ASG Ni 23 Mn 4	2.6	1.5 to 2.5	4.0 to 4.5	22.0 to 24.0	0.2, <i>Max</i>	0.080	0.5
ASG Ni 30 Cr 1	2.6	1.5 to 3.0	0.5 to 1.5	28.0 to 32.0	1.0 to 1.5	0.080	0.5
ASG Ni 30 Cr 3	2.6	1.5 to 3.0	0.5 to 1.5	28.0 to 32.0	2.5 to 3.5	0.080	0.5
ASG Ni 30 Si 5 Cr 5	2.6	5.0 to 6.0	0.5 to 1.5	28.0 to 32.0	4.5 to 5.5	0.080	0.5
ASG Ni 35	2.4	1.5 to 3.0	0.5 to 1.5	34.0 to 36.0	0.2, <i>Max</i>	0.080	0.5
ASG Ni 35 Cr 3	2.4	1.5 to 3.0	0.5 to 1.5	34.0 to 36.0	2.0 to 3.0	0.080	0.5

6. MECHANICAL TESTS

6.1 Tensile Test — The tensile test shall be carried out in accordance with IS:1608-1972* unless otherwise agreed to between the purchaser and the manufacturer. The test piece shall have a gauge diameter of 14 mm and a gauge length of 70 mm (see Fig. 1).



L_o = original gauge length ($L_o = 5d$ in this case),

d = original diameter of the test piece,

L_c = parallel length $L_c > L_o$ in principle $L_c - L_o > d$, and

L_t = total length of test piece according to L_c and l_t .

NOTE — The method of fixing ends of the test pieces together with their length l_t may be agreed by users.

All dimensions in millimetres.

FIG. 1 TENSILE TEST PIECE

6.1.1 To determine compliance with permanent set stress requirements, a tensioning load of not more than 1 000 kg shall be applied to the tensile test piece and the stress increased to the specified value, maintained for 15 seconds and then reduced to the tensioning value. The material shall be considered satisfactory if the gauge length has not then acquired a permanent strain greater than 0.5 percent.

6.1.2 Tensile properties of the grades of austenitic cast iron shall be in accordance with Table 1 for flake graphite types, and Table 3 for spheroidal graphite types.

6.2 Hardness Test — The hardness test shall be carried out in accordance with IS:1789-1961† and the Brinell hardness values shall be as specified in Tables 1 and 3.

*Method for tensile testing of steel products other than sheet, strip, wire and tubes (first revision).

†Method for Brinell hardness test for grey cast iron.

**TABLE 3 MECHANICAL PROPERTIES FOR SPHEROIDAL GRAPHITE
AUSTENITIC CAST IRONS**

(Clauses 6.1.2, 6.2 and 6.3.2)

GRADE	MECHANICAL PROPERTIES			MINIMUM MEAN IMPACT VALUE OF 3 TESTS		
	Tensile Strength, <i>Min</i> *N/mm ²	0.2 Percent Proof Stress, <i>Min</i> *N/mm ²	Elongation, <i>Min</i> Gauge Length 5.65√ <i>S₀</i> Percent	V-Notch (Charpy) J†	U-Notch (Mesnager) J†	Brinell Hardness HB, <i>Max</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ASG Ni 13 Mn 7	390	210	15	16	Not indicated	170
ASG Ni 20 Cr 2	370	210	7	13	16	200
ASG Ni 20 Cr 3	390	210	7	Not indicated	Not indicated	255
ASG Ni 20 Si 5 Cr 2	370	210	10	Not indicated	Not indicated	230
ASG Ni 22	370	170	20	20	24	170
ASG Ni 23 Mn 4	440	210	25	24	28	180
ASG Ni 30 Cr 1	370	210	13	Not indicated	Not indicated	190
ASG Ni 30 Cr 3	370	210	7	Not indicated	Not indicated	200
ASG Ni 30 Si 5 Cr 5	390	240	Not indicated	Not indicated	Not indicated	250
ASG Ni 35	370	210	20	Not indicated	Not indicated	180
ASG Ni 35 Cr 3	370	210	7	Not indicated	Not indicated	190

*1N/mm² = 1 MN/m² = 0.102 0 kgf/mm².

†1J = 1 N.m.

6.3 Impact Test—The impact test shall be carried out either on a U-notch test piece in accordance with IS: 1499-1959* or on a V-notch (charpy) test piece in accordance with IS: 1757-1961†. The dimensions of the U-notch and V-notch test pieces shall be in accordance with Fig. 2 and 3.

6.3.1 Unless specified otherwise, the impact test shall be carried out with the test piece at room temperature.

6.3.2 The impact values for spheroidal graphite austenitic cast irons shall be as specified in Table 3.

6.4 By agreement between the purchaser and the manufacturer mechanical tests for flake graphite iron may be waived.

7. RE-TEST

7.1 If the tensile test piece breaks outside the gauge length, or if, in any test, there are obvious casting defects, another test piece may be taken from the same sample, or cut from a casting represented by that sample.

7.1.1 If the sample is taken from the casting, the values of mechanical properties shall be the subject of mutual agreement between the purchaser and the manufacturer.

7.2 If any of the test pieces fails to comply with the test requirements, two further samples shall be selected for re-test from the samples obtained from the same ladle of metal as the test piece that failed. Should either of the re-test samples fail to meet the specified requirements, the castings represented shall be deemed as not complying with this standard.

7.3 In the case of castings supplied in the heat-treated condition the manufacturer shall have the right to reheat-treat the castings together with the representative test samples and re-submit them for testing.

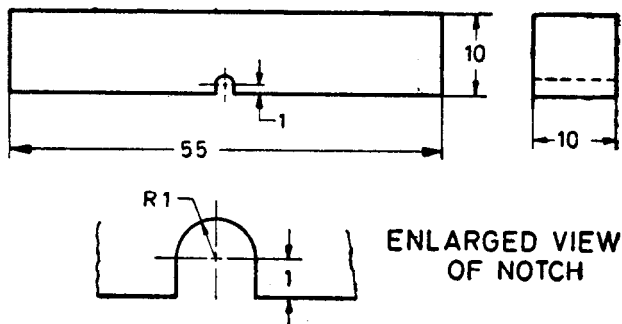
8. TEST SAMPLES

8.1 Test samples (often called keel blocks) shall be cast in sand moulds and shall be poured simultaneously with or immediately after pouring the casting from the same ladle of metal as that used to produce the castings they represent. They shall be poured separately. Recommendations regarding test samples are given in Appendix B.

8.1.1 In exceptional cases and by agreement between the parties concerned, the test samples may be attached to the castings; in such cases their location shall be agreed to between the purchaser and the manufacturer.

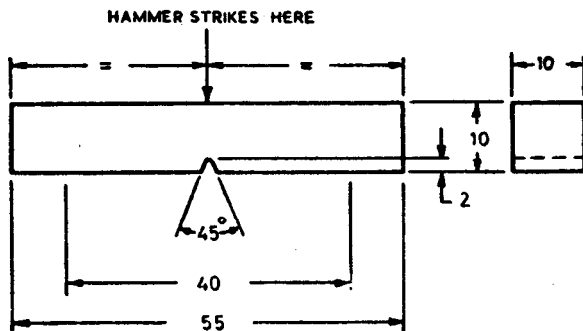
*Method of charpy impact test (U-notch) for steel.

†Method for beam impact test (V-notch) on steel.



All dimensions in millimetres.

FIG. 2 MESNAGER U-NOTCH TEST PIECE



All dimensions in millimetres.

FIG. 3 CHARPY V-NOTCH BEAM TYPE TEST PIECE, 10 mm SQUARE

8.2 When castings are supplied in the heat-treated condition, all test samples shall be heat-treated similar to, simultaneously with and adjacent to the castings they represent.

8.3 All test samples shall be suitably marked to identify them with the castings they represent.

9. HEAT TREATMENT

9.1 The castings may be supplied in heat treated condition if agreed to between the purchaser and the manufacturer.

10. WORKMANSHIP AND FINISH

10.1 The castings shall be accurately moulded in accordance with the pattern or working drawings supplied by the purchaser, with the addition of such letters, figures and marks as may be specified.

10.2 The purchaser shall specify the tolerances on all important dimensions. On other dimensions, tolerances specified in IS: 5519-1969* shall apply.

11. FREEDOM FROM DEFECTS

11.1 The castings shall be sound, clean and free from distortion and injurious defects. They shall be well-dressed and fettled and shall be free from chill except as specified by the purchaser. They shall be machinable using normal methods.

12. MARKING

12.1 Where practicable, each casting shall be legibly marked with an identification mark by which it can be traced to the melt and the batch of heat treatment, where applicable, from which it was made.

12.2 By agreement between the purchaser and the manufacturer, castings, complying with the requirements of this standard may, after inspection, be legibly marked with an acceptance mark.

12.2.1 The castings may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

*Deviations for untoleranced dimensions of grey iron castings.

13. SAMPLING

13.1 For quality control during production, use of control chart technique is recommended to the manufacturer for which reference is invited to IS: 397-1952*. The results of such tests done at the place of manufacture may be made available, along with the material supplied, to enable the purchaser to judge its acceptability.

13.2 Sampling for Chemical Analysis — Chemical analysis shall be carried out on metal chips left out of the cast test sample after making out the test pieces for other tests representing each melt. In the case of continuous melting, samples shall be provided at the rate of one sample per hour of production.

13.3 Sampling for Mechanical Tests

13.3.1 Iron Castings, Flake Graphite Type — If specified by the purchaser, one tensile test shall be carried out for each melt but in case of continuous melting, sufficient number of samples shall be provided to ensure one tensile test per hour of production.

13.3.2 Iron Castings, Spheroidal Graphite Type

13.3.2.1 If one ladle of metal is used to produce one or more castings, one tensile test shall be made on a test sample poured from that ladle.

13.3.2.2 If successively treated ladles filled from one furnace are used to produce a number of castings, one tensile test shall be made for each 500 kg of castings or part thereof. The manufacturer shall take steps to ascertain that the treatment of all the ladles is correct by such methods as may be agreed to between the purchaser and the manufacturer. The purchaser may examine the procedure adopted and satisfy himself that this is adequate.

13.3.2.3 When large tonnage of castings are produced continuously, the minimum number of test bars to be provided shall be one tensile test bar representing each two hours' production from one melting furnace.

13.3.2.4 If more than one ladle is used in making one casting, one tensile test shall be carried out on a sample poured from each ladle, and the quality of metal in other ladles checked as in **13.3.2.2**.

13.4 Hardness test shall be carried out either on castings or on test samples representing each melt as agreed to between the purchaser and the manufacturer.

13.5 Where impact test is required, one set of three impact values shall be obtained for each tensile test specified in **13.3.2.1** to **13.3.2.4**.

*Method for statistical quality control during production by the use of control chart (tentative).

APPENDIX A

(Clause 0.6)

SUPPLEMENTARY DATA ON MECHANICAL AND PHYSICAL PROPERTIES AND TYPICAL APPLICATIONS OF AUSTENITIC CAST IRON (FOR INFORMATION PURPOSES ONLY)

A-1. GENERAL

A-1.1 In determining the physical properties of austenitic cast iron, it should be borne in mind that the casting skin does not in general exhibit the same properties as the base material. This is valid in particular in determining electrical and magnetic properties. Therefore, before any such measurement is made, the casting skin shall be carefully removed. In so doing, the material shall not be subjected to mechanical stresses so severe that it exhibits plastic flow on the surface as, in that case, the surface will once again exhibit different properties from the base material. Therefore, the best test procedures are those in which the property to be measured is determined over a test piece volume that is not too small.

It is recommended that a round test piece, about 10 mm in diameter and 100 mm in length, should be carefully machined (low depth and speed of cut) from a test sample cast along with the casting. The test piece shall then be carefully pickled as traces of deformation martensite or ferromagnetic tool particles adhering to the surface tend to give incorrect measurements.

A-2. DATA

A-2.1 Flake Graphite Austenitic Cast Irons

A-2.1.1 Table 4 gives the mechanical properties.

A-2.1.2 Table 5 gives the physical properties.

A-2.1.3 Table 6 gives the typical applications and some characteristics.

A-2.2 Spheroidal Graphite Austenitic Cast Irons

A-2.2.1 Table 7 gives the mechanical properties.

A-2.2.2 Table 8 gives the physical properties.

A-2.2.3 Table 9 gives the typical applications and some characteristics.

A-2.2.4 Table 10 gives typical mechanical properties of grade ASG Ni 23 Mn 4 at low temperatures (-196°C).

**TABLE 4 MECHANICAL PROPERTIES OF FLAKE GRAPHITE
AUSTENITIC CAST IRONS**

(Clause A-2.1.1)

GRADE	MECHANICAL PROPERTIES				
	Tensile Strength* N/mm ²	Compressive Strength N/mm ²	Elongation Percent	Elastic Modulus† GN/m ²	Brinell Hardness HB
(1)	(2)	(3)	(4)	(5)	(6)
AFG Ni 13 Mn 7	140 to 220	630 to 840	Not indi- cated	70 to 90	120 to 150
AFG Ni 15 Cu 6 Cr 2	170 to 210	700 to 840	2	85 to 105	140 to 200
AFG Ni 15 Cu 6 Cr 3	190 to 240	860 to 1 100	1 to 2	98 to 113	150 to 250
AFG Ni 20 Cr 2	170 to 210	700 to 840	2 to 3	85 to 105	120 to 215
AFG Ni 20 Cr 3	190 to 240	860 to 1 100	1 to 2	98 to 113	160 to 250
AFG Ni 20 Si 5 Cr 3	190 to 280	860 to 1 100	2 to 3	110	140 to 250
AFG Ni 30 Cr 3	190 to 240	700 to 910	1 to 3	98 to 113	120 to 215
AFG Ni 30 Si 5 Cr 5	170 to 240	560	Not indi- cated	105	150 to 210
AFG Ni 35	120 to 180	560 to 700	1 to 3	74	120 to 140

*The minimum tensile strengths indicated are mandatory (see 6.1.2 and Table 1).

†1 GN/m² = 1 N/mm² × 10³.

TABLE 5 PHYSICAL PROPERTIES OF FLAKE GRAPHITE AUSTENITIC CAST IRONS

(Clause A-2.1.2)

GRADE	PHYSICAL PROPERTIES					
	Nomial Density Mg/m ³	Thermal Coefficient of Expansion (20 to 200°C) m/(m. °C) × 10 ⁻⁶	Thermal Conducti- vity W/(m. °C)	Specific Heat J/(g.°C)	Specific Electrical Resistance Ω mm ² /m	Relative Permeability μ (where H = 8 kA/m)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AFG Ni 13 Mn 7	7.3	17.7	37.7 to 41.9	0.46 to 0.50	1.4	1.02
AFG Ni 15 Cu 6 Cr 2	7.3	18.7	37.7 to 41.9	0.46 to 0.50	1.6	1.03
AFG Ni 15 Cu 6 Cr 3	7.3	18.7	37.7 to 41.9	0.46 to 0.50	1.1	1.05
AFG Ni 20 Cr 2	7.3	18.7	37.7 to 41.9	0.46 to 0.50	1.4	1.04
AFG Ni 20 Cr 3	7.3	18.7	37.7 to 41.9	0.46 to 0.50	1.2	1.04
AFG Ni 20 Si 5 Cr 3	7.3	18.0	37.7 to 41.9	0.46 to 0.50	1.6	1.1
AFG Ni 30 Cr 3	7.3	12.4	37.7 to 41.9	0.46 to 0.50	Not indicated	Not indicated
AFG Ni 30 Si 5 Cr 5	7.3	14.6	37.7 to 41.9	0.46 to 0.50	1.6	2
AFG Ni 35	7.3	5.0	37.7 to 41.9	0.46 to 0.50	Not indicated	Not indicated

**TABLE 6 PROPERTIES AND TYPICAL APPLICATIONS OF FLAKE
GRAPHITE AUSTENITIC CAST IRONS**

(Clause A-2.1.3)

GRADE	PROPERTIES*	TYPICAL APPLICATIONS
(1)	(2)	(3)
AFG Ni 13 Mn 7	Non-magnetic	Such applications as pressure covers for turbine generator sets, housings for switchgear, insulator flanges, terminals and ducts
AFG Ni 15 Cu 6 Cr 2	Good resistance to corrosion, particularly in alkalis, dilute acids, sea water and salt solutions. Good heat resistance, good bearing properties, high thermal expansion, non-magnetic at low chromium contents Better corrosion and erosion resistance than Grade AFG Ni 15 Cu 6 Cr 2	Such applications as pumps, valves, furnace components, bushings, piston ring carriers for light alloy metal pistons
AFG Ni 15 Cu 6 Cr 3		
AFG Ni 20 Cr 2	Similar to AFG Ni 15 Cu 6 Cr 2, but more corrosion resistant to alkalis. High coefficient of thermal expansion	As for AFG Ni 15 Cu 6 Cr 2, but preferable for pumps handling alkalis, used in the soap, food, artificial silk and plastics industries. Suitable where copper-free materials are required
AFG Ni 20 Cr 3	As AFG Ni 20 Cr 2, but more resistant to erosion, heat and growth	As AFG Ni 20 Cr 2, but preferred also for high temperature applications
AFG Ni 20 Si 5 Cr 3	Good resistance to corrosion, even to dilute sulphuric acid. More heat resistant than AFG Ni 20 Cr 2 and AFG Ni 20 Cr 3. This grade is not suitable for use in the temperature range 500 to 600°C	Such applications as pump components, valve castings for industrial furnaces

(Continued)

**TABLE 6 PROPERTIES AND TYPICAL APPLICATIONS OF FLAKE
GRAPHITE AUSTENITIC CAST IRONS — *Contd***

(*Clause A-2.1.3*)

AFG Ni 30 Cr 3	Resistant to heat and thermal shock up to 800°C. Good corrosion resistance at high temperatures, excellent erosion resistance in wet steam and salt slurry, average thermal expansion	Such applications as pumps, pressure vessels, valves, filter parts, exhaust gas manifolds, turbo charger housings
AFG Ni 30 Si 5 Cr 5	Particularly resistant to corrosion, erosion and heat, average thermal expansion	Such applications as pump components, valve castings for industrial furnaces
AFG Ni 35	Resistant to thermal shock; low thermal expansion	Such applications as parts with dimensional stability (for example machine tools), scientific instruments, glass moulds

*The properties given depend on chemical composition (*see 5.2*).

TABLE 7 MECHANICAL PROPERTIES OF SPHEROIDAL GRAPHITE AUSTENITIC CAST IRONS

(Clause A-2.2.1)

GRADE	MECHANICAL PROPERTIES					
	Tensile Strength N/mm ²	0.2 Percent Proof Stress N/mm ²	Elongation Percent	Elastic Modulus* GN/m ²	Charpy V-Notch Impact Strength† J	Brinell Hardness, HB
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ASG Ni 13 Mn 7	390 to 460	210 to 260	15 to 25	140 to 150	15.0 to 27.5	130 to 170
ASG Ni 20 Cr 2	370 to 470	210 to 250	7 to 20	112 to 130	13.5 to 27.5	140 to 200
ASG Ni 20 Cr 3	390 to 490	210 to 260	7 to 15	112 to 133	12.0	150 to 255
ASG Ni 20 Si 5 Cr 2	370 to 430	210 to 260	10 to 18	112 to 133	14.9	180 to 230
ASG Ni 22	370 to 440	170 to 250	20 to 40	85 to 112	20.0 to 33.0	130 to 170
ASG Ni 23 Mn 4	440 to 470	210 to 240	25 to 45	120 to 140	24.0	150 to 180
ASG Ni 30 Cr 1	370 to 440	210 to 270	13 to 18	112 to 130	17.0	130 to 190
ASG Ni 30 Cr 3	370 to 470	210 to 260	7 to 18	92 to 105	8.5	140 to 200
ASG Ni 30 Si 5 Cr 5	390 to 490	240 to 310	1 to 4	91	3.9 to 5.9	170 to 250
ASG Ni 35	370 to 410	210 to 240	20 to 40	112 to 140	20.5	130 to 180
ASG Ni 35 Cr 3	370 to 440	210 to 290	7 to 10	112 to 123	7.0	140 to 190

*1GN/m² = 1 N/mm² × 10³.

†1J = 1 N.m.

TABLE 8 PHYSICAL PROPERTIES OF SPHEROIDAL GRAPHITE AUSTENITIC CAST IRONS

(Clause A-2.2.2)

GRADE	PHYSICAL PROPERTIES				
	Nominal Density Mg/m ³	Thermal Coefficient of Expansion (20 to 200°C) m/ (m. °C) × 10 ⁻⁶	Thermal Conductivity W/ (m. °C)	Specific Electrical Resistance Ω mm ² /m	Relative Permeability μ (where H = 8 kA/m)
(1)	(2)	(3)	(4)	(5)	(6)
ASG Ni 13 Mn 7	7.3	18.2	12.6	1.0	1.02
ASG Ni 20 Cr 2	7.4	18.7	12.6	1.0	1.04
ASG Ni 20 Cr 3	7.4	18.7	12.6	1.0	1.05
ASG Ni 20 Si 5 Cr 2	7.4	18.0	12.6	Not indicated	Not indicated
ASG Ni 22	7.4	18.4	12.6	1.0	1.02
ASG Ni23 Mn 4	7.4	14.7	12.6	Not indicated	Not indicated
ASG Ni 30 Cr 1	7.4	12.6	12.6	Not indicated	Not indicated
ASG Ni 30 Cr 3	7.4	12.6	12.6	Not indicated	Not indicated
ASG Ni 30 Si 5 Cr 5	7.4	14.4	12.6	Not indicated	Not indicated
ASG Ni 35	7.6	5	12.6	Not indicated	Not indicated
ASG Ni 35 Cr 3	7.6	5	12.6	Not indicated	Not indicated

**TABLE 9 PROPERTIES AND TYPICAL APPLICATIONS OF SPHEROIDAL GRAPHITE
AUSTENITIC CAST IRONS**

(Clause A-2.2.3)

GRADE	PROPERTIES*	TYPICAL APPLICATIONS
(1)	(2)	(3)
ASG Ni 13 Mn 7	Non-magnetic	Such applications as pressure covers for turbine generator sets, housings for switchgear insulator flanges, terminals and ducts
ASG Ni 20 Cr 2	Similar to AFG Ni 20 Cr 2 in relation to composition, corrosion and heat resistance	Such applications as pumps, valves compressors, bushings, turbosupercharger housings, exhaust gas manifolds
ASG Ni 20 Cr 3	Similar to ASG Ni 20 Cr 2, but better erosion and heat resistance	
ASG Ni 20 Si 5 Cr 2	Good resistance to corrosion even to dilute sulphuric acid. Good heat resistance. This grade is not suitable for use in the temperature range 500 to 600°C	Such applications as pump components, valves, castings for industrial furnaces subject to high mechanical stress
ASG Ni 22	High coefficient of thermal expansion, lower corrosion and heat resistance than ASG Ni 20 Cr 2. Good impact properties down to -100°C. Non-magnetic	Such applications as pumps, valves, compressors, bushings, turbosupercharger housings, exhaust gas manifolds
ASG Ni 23 Mn 4	Good impact properties down to -196°C. Non-magnetic	Such applications as castings for refrigeration engineering for use down to -196°C (see Table 10)
ASG Ni 30 Cr 1	Similar to ASG Ni 30 Cr 3. Good bearing properties	Such applications as pumps, boilers, filter parts, exhaust gas manifolds, valves, turbosupercharger housings
ASG Ni 30 Cr 3	Similar to AFG Ni 30 Cr 3	Such applications as pumps, boilers, valves, filter parts, exhaust gas manifolds, turbosupercharger housings
ASG Ni 30 Si 5 Cr 5	Properties similar to AFG Ni 30 Si 5 Cr 5	Such applications as pump components, valves castings for industrial furnaces subject to high mechanical stress
ASG Ni 35	Low thermal expansion similar to AFG Ni 35, but more resistant to thermal shock	Parts with dimensional stability (for example, machine tools), scientific instruments, glass moulds
ASG Ni 35 Cr 3	Similar to ASG Ni 35	Parts of gas turbine housings, glass moulds

*The properties given depend on the chemical composition (see 5.2). All grades, with the exception of grade ASG Ni 13 Mn 7, will have improved creep resistance properties by the addition of 1 percent by mass of molybdenum.

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TABLE 10 TYPICAL MECHANICAL PROPERTIES OF ASG Ni 23 Mn 4 AT LOW TEMPERATURES*(Clause A-2.2.4)*

TEMPER- ATURE °C	TENSILE STRENGTH N/mm ²	0.2 PERCENT PROOF STRESS N/mm ²	ELONGATION, PERCENT	REDUCTION IN AREA AFTER FRACTURE, PERCENT	CHARPY V-NOTCH IMPACT STRENGTH* J
(1)	(2)	(3)	(4)	(5)	(6)
+20	450	220	35	32	29
0	450	240	35	32	31
-50	460	260	38	35	32
-100	490	300	40	37	34
-150	530	350	38	35	33
-183	580	430	33	27	29
-196	620	450	27	25	27

*1 J = 1N.m.

APPENDIX B*(Clause 8.1)***RECOMMENDATIONS FOR CASTING OF TEST SAMPLES****B-1. FOR FLAKE GRAPHITE GRADES**

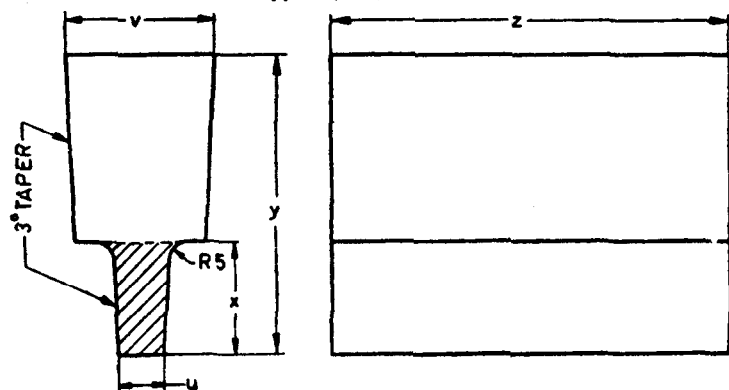
B-1.1 The test pieces, representative of the flake graphite grades, shall either be prepared in accordance with **8.1** and **B-2** or be prepared from a separately cast round bar test sample of 25 mm diameter.

B-2. FOR SPHEROIDAL GRAPHITE GRADES

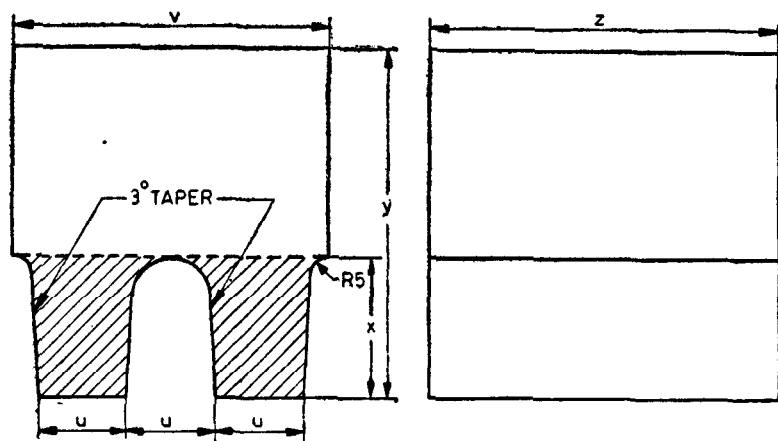
B-2.1 The test pieces representative of spheroidal graphite grades and used for the tests specified in **6** shall be taken from the keel of the U type test sample (the hatched section of Fig. 4) and machined in accordance with Fig. 1.

B-2.2 In principle, test sample Type IIa or IIb, or 25 mm effective thickness, shall be used; however; if its mass effect differs widely from that of the casting it represents, other test samples, such as Types I, III and IV of Fig. 4 may be used by agreement between the purchaser and the manufacturer, or the mechanical properties may be measured using test pieces machined from either the Y type test sample in Fig. 5, or the knock-off type in Fig. 6.

Types I, IIa, III and IV



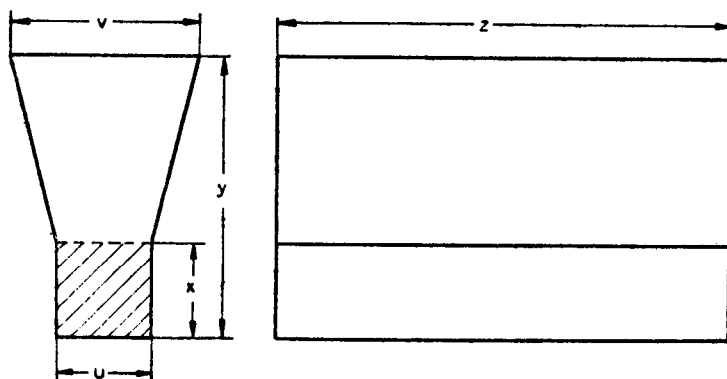
Type IIb



DIMENSION	TYPE				
	I	IIa	IIb	III	IV
<i>u</i>	12	25	25	50	75
<i>v</i>	40	55	90	90	125
<i>x</i>	30	40	40	60	65
<i>y</i>	80	100	100	150	165
<i>z</i>	A function of the test piece length				

All dimensions in millimetres.

FIG. 4 U-TYPE TEST SAMPLES



DIMENSION	TYPE			
	I	II	III	IV
u	12	25	50	75
v	40	55	100	125
x	25	40	50	65
y	135	140	150	175
z	A function of the test piece length			

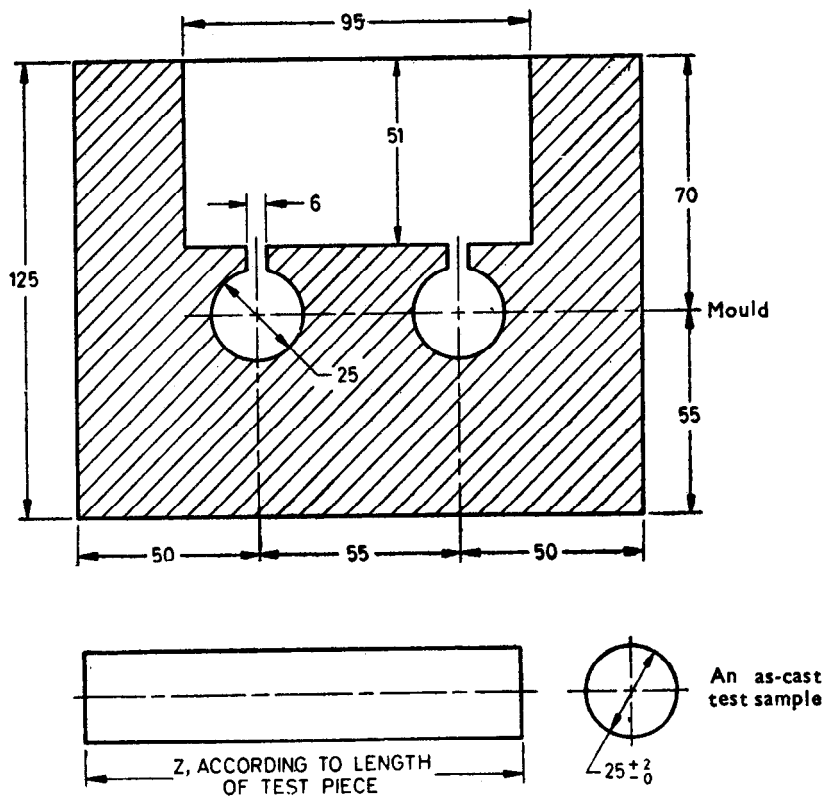
NOTE—The thickness of the sand mould surrounding the test sample during casting will be:

40 mm minimum for Types I and II.

80 mm minimum for Types III and IV.

All dimensions in millimetres.

FIG. 5 Y-TYPE TEST SAMPLES



All dimensions in millimetres.

FIG. 6 'KNOCK-OFF' TYPE TEST SAMPLES

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